AMENDED SPECIFICATION

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PATENT SPECIFICATION

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By a direction given under Section 17(i) of the Patents Act 1949 this application proceeded in the name of ARMSTRONG SIDDELEY MOTORS LIMITED, of Park Side, Coventry, Warwickshire, a British Company.

COMPLETE SPECIFICATION

Labyrinth Packings of Internal-Combustion Turbine Units

We, ARMSTRONG SIDDELEY MOTORS LIMITED, a British Company, and THOMAS CLARK, a British Subject, both of the Company's address, Park Side, Coventry, Warwickshire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an internal-combustion turbine unit where gas temperatures of 800° C. or higher may normally be encountered in the turbine.

Our main object is to provide an improved labyrinth gland or packing for the turbine rotor.

It has been proposed, as disclosed in an article of the issue of the Motor Ship for April, 1946, that, in the case of a closed air circuit compressor-turbine unit in which external heat is appropriately added to the air the rotating shafts of the machines should be sealed from the ambient air by means of axial labyrinth glands or packings. One of these is shown (in the said article) as comprising two axially-spaced portions having between them an annular space which is fed with sealing air, extracted from the circuit, which is at all loads at a higher pressure than that in the gland, that portion of the gland between the annular space and the ambient air end of the gland being axially longer than the other portion.

It has also been proposed, as described in some detail in the issue of "Engineer" for 19th July, 1946, that, in the case of a gas turbine engine, there should be a labyrinth gland or packing at each end of the turbine to the centre of which cool air is supplied under pressure so as to prevent the escape of any of the products of combustion and, at the same time, to cool the shaft.

The present invention consists in providing a radial labyrinth packing, for the turbine rotor of an internal-combustion turbine unit, in the form of two radially-spaced portions, and in supplying relatively cool air, at a pressure in excess of that of the turbine gases, from the compressor of the unit to the annular space between the two radially-spaced portions.

The single figure of the accompanying drawings is a fragmentary sectional elevation showing one form of radial labyrinth packing, according to the invention, between relatively-rotatable members of an internal-combustion turbine.

A portion of the turbine stator casing is shown at 10 and part of one of the first circle of stator blades at 11, whilst 12 represents part of one of the first circle of rotor blades carried by the rotor 13. The latter is journalled, as disclosed in British Patent Specification No. 579,775, in a bearing carrier having an annular supporting ring or disc 15. As the rotor shaft (not shown), which is axially located on its left-hand end, may extend axially towards the right as working temperatures are

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being reached, the bearing supporting ring 15 moving correspondingly to the right to a greater or less extent, the ring 15 is connected to an annular disc 16, fast with the stator casing 10, by means of a flexible bellows device, indicated at 17. This bellows device is an annular one, its outside flanges being clamped by means of securing members 18, 18.

The turbine rotor 13 is supported from the rotor shaft by being bolted, as shown at 20, to an annular disc 21 which is actually fast with the shaft, as disclosed in British Patent Specification No. 579,426.

The combustion gases passing between the first circle of the stator blades 11 are at a relatively high temperature of, for example, 800° C. or 900° C., and the problem is to provide a seal for them which will withstand such high temperatures and which will still provide sealing when different extensions occur as working temperatures are being reached, the seal to be between the stator casing 10 and the rotor 13 or between parts attached thereto.

In the present instance the seal or labyrinth packing is a radial one provided between the adjacent radial faces of the discs 15 and 21, and it takes the form of a number of annular sealing strips 23, 23 secured to one of these faces, at different radial spacings, and extending towards and coacting with the other radial face, the latter radial face being formed with a series of annular grooves and ridges, as indicated at 24, 25, or arranged in corresponding manner to provide a staggered (in a radial direction) clearance path.

It will be observed that in the present instance the annular sealing strips 23 are supported by the stationary disc 15, the adjacent surface of the rotor disc 21 having the annular grooves and ridges 24, 25.

In the present instance the labyrinth packing is divided up into two radially-unequal portions, A and B, by an annular space 27, the portion A, between the space 27 and the turbine gases, being shorter in a radial direction than the portion B, between the space 27 and the ambient pressure at 28.

Communicating with the space 27 is a passage 29 connected by a passage 30 to an opening 31 in the interior of the stationary disc 15, which opening is in turn connected to a pipe 32. This latter is supplied by the compressor for the turbine with air which, whilst being raised in temperature to a considerable degree by being compressed, is nevertheless relatively cool compared with the temperature of the combustion gases which leak between the end 33 of the stator casing and the adjacent portion of the rotor 13, and the pressure at which this air is supplied is higher than the pressure of the said gases, for example, by 10 pounds per square inch or so. Thus, if there is a tendency for the axial spacing between the discs 15 and 21 to increase beyond the design limit, the air pressure in the space 27 prevents the passage of the hot gases through the portion B of the labyrinth whilst the compressed air can leak therealong, and some of the latter can in like manner leak through the labyrinth portion A, to be absorbed in the turbine.

In a similar manner, if, in course of time, the labyrinth portion A should deteriorate due to the action of the hot gases, then there will be a greater flow of the relatively cool air through the labyrinth portion A, but the hot gases will be prevented from escaping through the labyrinth portion B.

It will be understood that, in practice, the opening 31 may be an annular one communicating with a plurality of circumferentially-spaced pipes 32 and connected at intervals with the annular space 27 by other passages 29, 30.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. An internal combustion turbine unit having a turbine rotor provided with a radial labyrinth packing in the form of two radially-spaced portions, and having relatively cool air, at a pressure in excess of that of the turbine gases, supplied from the compressor of the unit to the annular space between the two radially-spaced portions.

2. An internal-combustion turbine unit, according to Claim 1, characterised in that the radial portion of the packing on the side of the annular space towards the gases is of less radial length than the other portion.

3. An internal-combustion turbine unit having a labyrinth packing, for the turbine rotor, arranged and supplied with cooling air substantially as described with reference to the accompanying drawings.

Dated this 18th day of August, 1947.

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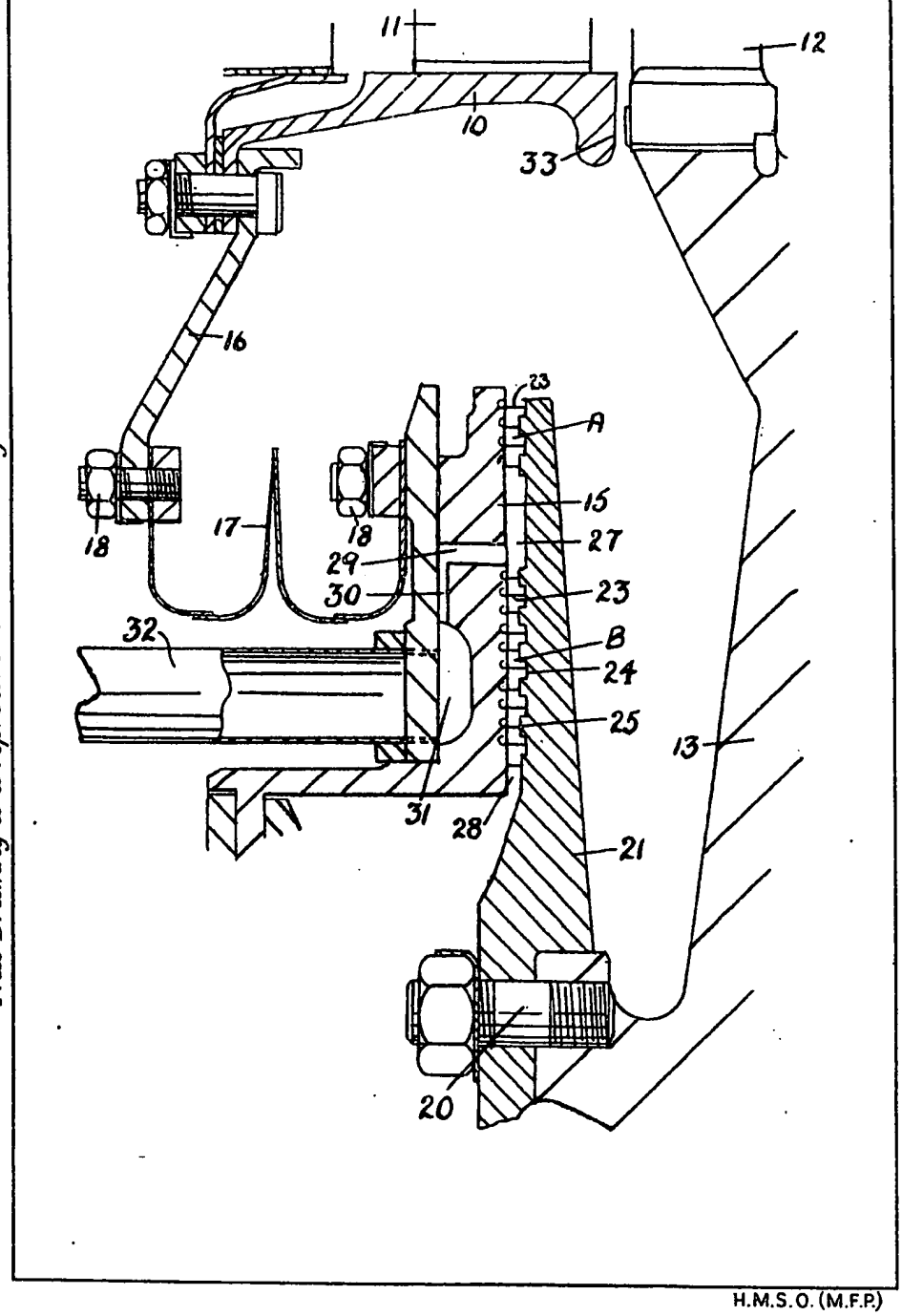

H.M.S.O. (M.F.P.)